effectively cooled out by repeated immersions than would be the case if a solid conductor of the same cross-sectional area were employed.

The cases to which the process is applicable in scientific work are obvious and numerous, and it is needless to specify them. In view of the number of applications of a commercial and industrial value, as *e.g.* in the manufacture of incandescent electric lamps, mercury-vapour lamps, etc., the process has been protected by patent in Great Britain and abroad; but I understand that this protection is not intended to restrict in any way its use in research laboratories or its application to any purposes of a purely scientific and unremunerative nature. F. F. S. BRYSON.

Natural Philosophy Institute, University of Glasgow, May 24.

## Eryonicus-Polycheles.

IN a recent publication on the Crustacea of Ireland, "Decapoda Reptantia of Ireland," Part I., by C. M. Selbie (Fisheries, Ireland, Sci. Invest., 1914, I. (1914)), the question of whether the peculiar forms known as Eryonicus are larvæ of the crayfish-like deep-sea crustaceans Polycheles is answered to the effect that they are independent animals constituting a genus related to Polycheles.

As these animals since the days of the *Challenger* Expedition have enjoyed a special interest as the modern survivors of a group almost until then believed to be confined to Jurassic and Cretaceous times, I thought it might possibly interest some of your zoologist readers to learn about some of the results obtained through the study of the material collected in the North Atlantic by the *Michael Sars* in 1910 during the cruise undertaken by the late Sir John Murray and Dr. Johan Hjort.

To begin with, it must be mentioned that the best specific characters both in Polycheles and Eryonicus are derived from the arrangement of the spines on the carapace. Now a peculiar correspondence is observed in several species of the two "genera," making it possible to "pair" several of the Eryonicus species each with one of the Polycheles species, as will be seen from the following formula representing the position of spines in the median line of the carapace. In these formulæ, 1 and 2 denote single and double *pointed* spines, while 3 denotes a single *blunt* spine, and *c* the position of the cervical groove, the rostral spines being to the left:—

| | | |
|---|---|---|
| *E. faxoni*, Bouvier ... ... | 2.1.2.1.3.*c*.2.2.3.2 | *a* |
| *P. sculptus*, Smith ... ... | 2.1.2.1. *c*.2.2. 2 | |
| *E. coecus*, Faxon ... ... | 2.1.2.1.1[1].*c*.2.2.1[1].2 | *b* |
| *P. sculptus pacificus*, Faxon | 2.1.2.1. *c*.2.2. 2 | |

The two species *a* live in the Atlantic, the species *b* in the Pacific. The only difference between the two pairs consists in *b* having a spine on the cardiac area on each side, this spine being absent in all specimens of *a* examined by Mr. Selbie and myself:—

| | | |
|---|---|---|
| *E. hibernicus*, Selbie... ... | 2.1.1.2.3.1.*c*.2.2.3.2 | *c* |
| *P. nanus*, Smith... ... ... | 2.1.1.2. 1.*c*.2.2. 2 | |
| *E. spinulosus*, Faxon ... | 2.1.1.1.2.1[1].1[1].*c*.2.2.1[1].2 | *d* |
| *P. tanneri*, Faxon ... ... | 2.1.1.1.2. *c*.2.2. 2 | |
| *E. kempi*, Selbie... ... ... | 1.1.1.1.2.1. *c*.2.2.3.2 | *e* |
| *P. typhlops*, Heller ... ... | 1.1.1.1.2.(2)*c*.(2).(2). 2 | |

The figures within brackets in the formula for *P. typhlops* denote that these spines in some of Mr. Selbie's specimens were of reduced size, single, or wholly rudimentary. It will be noted that the spines known or supposed to be blunt have no equivalent in the corresponding Polycheles.

Now, I ask, is it possible to explain the above correspondences as mere accident, or are they not to be taken as evidence of the Eryonicus species being in fact larval Polycheles?

One of the commonest objections to this theory is the giant size presented by some of the Eryonicus-specimens compared with the smaller Polycheles-individuals, though this need not signify much. Like so many other plankton animals, the Eryonicus are of a nearly jellyfish-like consistency, and it may as well be conceived that an Eryonicus can shrink into a small Polycheles, as that the Leptocephali, when turning into "montée," lose about 78 per cent. in weight (in dry matter they lose over 32 per cent.), according to Dr. Johs. Schmidt, the Danish specialist on eels.

If Eryonicus were adult animals, it would be rather remarkable that not a single egg-bearing female has been found among the fifty-nine specimens known to have been captured (Mr. Selbie, *op. cit.*, mentions thirty-five specimens, and the *Michael Sars* got twenty-four). It cannot matter much that secondary male sexual characters in different stages of development have been found in a few of the largest specimens.

Finally, it must be mentioned that one is at a loss where to seek the larvæ of Polycheles, which do not seem to be very rare animals (the Irish research steamer *Helga*, for instance, obtained thirty-two specimens) if these larvæ are not represented by Eryonicus.

For literature and details of the species in question, see Mr. Selbie's paper quoted above.

OSCAR SUND.

Bureau of Fisheries, Bergen, Norway, May 8.

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[1] These spines are represented by Faxon as being pointed. I believe from analogy with all the Irish and *Michael Sars* specimens that they are in fact blunt.

## The Age of the Earth.

IN NATURE of May 6, Mr. C. E. Stromeyer states that two conclusions in my letter published in your issue of April 22 are not correct; he claims, first, that the amount of energy lost by the earth is not compensated by the heat received from the sun; secondly, that meteoric bombardment of the sun has been left out of account as a source of energy.

As to the first point, the amount of energy lost in consequence of the temperature gradient in the earth's crust is of the order $1{\cdot}33\times10^{-6}\frac{\text{cal}}{\text{cm.}^2\text{sec.}}$. As this is 6000 times less than the total amount radiated, no useful purpose would be served by taking it into account.

As regards the second point, any heat due to meteoric bombardment up to date has been taken into account, as the sun's mass as it is known to-day was inserted in the calculation.

Perhaps the purport of my letter was not as clear as I could have wished. It was not so much my intention to weigh the evidence for or against an age of some twenty million years, as to emphasise the point that neither radio-activity nor any other known cause will account for a longer period. I have lately had the advantage of discussing the subject with Prof. Strutt, and must admit that the conclusions he has drawn from the helium contained in rocks appear unanswerable.

It would seem, therefore, that the origin of the sun's heat cannot be referred to any known cause.

Farnborough, May 15. F. A. LINDEMANN.

## Modern Substitutes for Butter.

THE issue of NATURE dated April 8 contains an article relating to "Modern Substitutes for Butter," which gives a highly interesting impression of the technical and scientific state to which the margarine industry has developed in recent years.

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Towards the end of the article, the author deals with the influence of vitamines, and indicates that, while these substances are present in butter, they would not be met with in margarine

This characteristic would meet the case as regards certain butter and margarine products, but by far the largest quantities of butter now on the market are made from pasteurised cream, and the pasteurisation would no doubt have reduced the original quantities of vitamines very considerably.

On the other hand, large quantities of margarine contain, among other fats, cold-pressed oils (such as ground-nut oil) which, like the better grades of olive oil, do not undergo any refining process whatever, and would therefore lend to the margarine their original content of vitamines.

If vitamines are produced in the lactic acid fermentation of milk, an abundance of these precious substances would be imparted to both butter and margarine, as in buttermaking the ripening takes place after the cream has been pasteurised, and in the manufacture of margarine the ripened skim milk is churned with the fat after the latter has been refined. Hence in both cases the vitamines produced in the fermentation process are not subsequently subjected to any harmful treatment.

It therefore appears that, so far as the presence or absence of vitamines is concerned, margarine would rank as equal to butter. There are, in fact, qualities of margarine on the market which contain a small proportion of fresh egg yolk, and such qualities would doubtless be of high standing as regards vitamines.

S. H. B.

So little is at present known about vitamines that "S. H. B." may well be correct in assuming their presence in cold-pressed oils, in ripened skim milk, and in fresh egg yolk. Even hot-pressed oils have probably not been subjected to such a temperature as to kill the vitamines.

On the other hand, if the present writer's memory is not at fault, the work of American investigators has shown that of several oils investigated, butter fat alone contained vitamines. There is also evidence to indicate that vitamines are closely associated with lipoids, and it is doubtful whether they would be formed during lactic fermentation. It is evident should vitamines be present in nut oils as suggested, that nuts might form a valuable preventative of beri-beri, or scurvy; the writer is unaware if this has been tested in practice.

As stated in the original article, probably sufficient vitamines are present in the rest of the dietary to enable them to be dispensed with in the fat.

THE WRITER OF THE ARTICLE.

May 20.

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## THE EXTINCTEUR AND ITS LIMITATIONS.

THE portable chemical fire-extinguisher, better known as extincteur, has been much before the public of late. Leaving aside the whole of those unfortunate appliances that belong to the dry powder class and the glass hand grenade type, which are entirely untrustworthy, the portable chemical fire-extinguisher in modern practice may be looked upon as a cylinder of from 2 to 3 gallons' capacity, containing water, with the addition of some substance which may, or may not, add to the efficiency of the extinguishing power of the water discharged.

There are, of course, one or two other forms of portable chemical liquid fire-extinguishers, *i.e.*, certain forms of less than a gallon capacity containing carbon tetrachloride or some combination thereof, intended for use on small petrol fires, and where the capacity is sufficient, say, from 2 quarts to 1 gallon, and the chemical is discharged automatically by some capsule of compressed air or the like, effective results are obtained from such appliances on small spirit fires. Where, however, the appliance only has the capacity of a pint or quart of carbon tetrachloride or some combination thereof, and has to be applied by manual action, the limit of effectiveness is certainly very small, a quart of chemical applied, say, by a double action squirt being able to deal at the most with a 2 gallon tin of petrol spilt over a motor-car or in some vessel of no great area. A weak spot in the use of carbon tetrachloride and its combinations, by the bye, is the fumes it gives off when in contact with fire. For this reason its use in enclosed spaces should in any case be avoided, and people suffering from liver complaint should in any case keep clear of this chemical when used on fires.

But to revert to the ordinary portable chemical liquid extinguisher of 2 to 3 gallons' capacity, as seen in many public buildings, and thus considered by the general public as something acceptable for every-day purposes. We are desirous of warning the public as to unsuitable purchases of such appliances. To begin with, in a very general way a portable liquid chemical fire-extinguisher is not the alpha and omega of first-aid fire-extinguishing, although there is no doubt that these appliances as such are popular. They look so bright and neat. Their presence advertises the owner's forethought. If finished on copper they are quite ornamental.

For the ordinary householder and for the ordinary business establishment where fire appliances are not under constant inspection, we would, however, rather pin our faith in the ordinary bucket of water energetically applied, and the ordinary miniature manual hand-pump or corridor engine. A few dozen buckets and a couple of hand-pumps, involving together perhaps an expenditure of 5*l.* to 6*l.*, will work wonders in a quite substantial fire, whilst the same 6*l.* will only produce three or four 2-gallon extinguishers, which require, as a rule, practice to discharge properly and time to re-charge at intervals; they require also most careful maintenance, and at the best will give the user some 6 or 8 gallons of chemically prepared water as against, say, the 50 gallons of water immediately available for continuous application and rapidly replenished without intervals. A small stirrup hand-pump of the London type, by the bye, can be worked single-handed to supply 4 to 5 gallons per minute at an effective range of 25 to 40 ft.

The whole principle of putting out a small fire is the cooling effect of water applied in fair bulk continuously and under pressure; and the cooling effect can be best obtained by a copious supply

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